



**Aerators on lagoon**



**Influent pipe to wetland**



**Wetland cell along barrier**



**Receiving stream**

## **Facility Description**

The Town of Crowley wastewater facility is a minor municipal lagoon system. 85 percent of the wastewater flow is attributed to the nearby prison and 15 percent is attributed to the Town of Crowley. The facility consists of three aerated lagoons, a polishing pond, two constructed wetland cells, and a chlorine contact

### **Crowley Facility Statistics**

Nearest Town:	Crowley
County:	Crowley
River Basin:	Lower Arkansas
Receiving Water Body:	Crowley Drain Canal
Year Online:	1996
Population:	1200
Elevation (feet):	4354
Design Flow (mgd):	0.170
Average Flow (mgd):	0.126
Size (acres):	3.04

chamber. The influent flow is measured by two ultrasonic meters with a totalizer. The effluent flow is measured by a 45° v-notch weir. This facility services a nearby correctional facility.

## **Lagoons**

The Crowley lagoons are configured as follows:

Lagoon Information				
Cell No.:	1	2	3	4
Surface Area (sq. ft.)	43,950	38,050	20,580	23,270
Avg. Depth (ft)	5.5	5.5	5.3	5.1
Avg. Volume (Million gallons)	1.57	1.313	0.658	0.723
Detention time (days)	9.2	7.7	3.9	4.3
Aerator size (hp)	36	10	5	NA

## **Background Information**

This surface flow wetland system was constructed in 1994. The incorporation of the constructed wetland treatment component was undertaken to polish lagoon systems effluent to remove particulate matter, primarily algae, and the organic load associated with the discharge of this particulate matter.

## **Energy Analysis**

The aerators on the lagoons consume the majority of the energy at this site. The site has a total of 6 – 5hp aerators and 8 – 3hp aerators.

## **Wetland Design**

### **Design Methods**

A review of literature indicates that the two most significant design parameters with regard to TSS control are hydraulic residence time and aspect ratio. The design of the wetland was based on a hrt of 6 days under summer operating conditions and a minimum aspect ratio of 10:1. BOD removal predicted by first order, plug flow, reaction kinetics model developed by Reed, Middlebrooks and Crites. A hydraulic loading rate of 1.228 gpd/ft<sup>2</sup> was selected. A common range for secondary and tertiary treatment is 15 to 25 acres / mgd. The wetland area provided is 3.042 acres, or a winter loading of 18.8 acres/mgd and a summer loading of 20.2 acres /mgd.

### **Objectives**

The wetland component was designed to remove BOD from the lagoon effluent as a result of algal carryover.

### Size

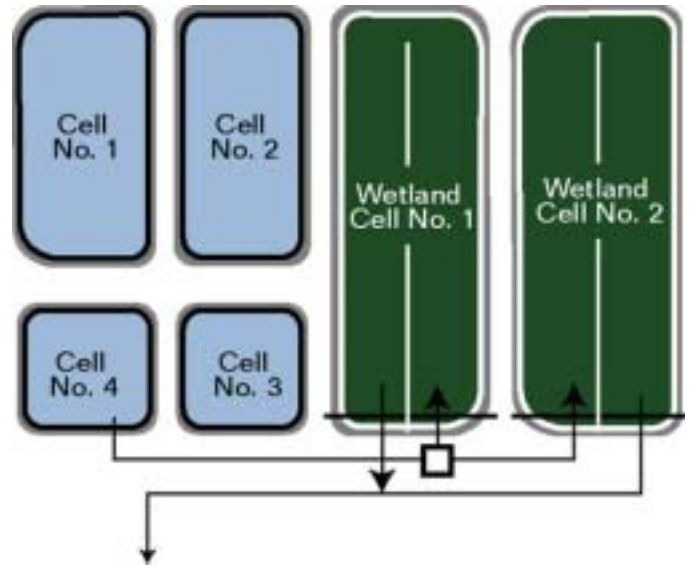
The cells have a total surface area of 132,500 square feet.

### Shape

The wetland cells are rectangular, with a serpentine flow pattern.

### Hydraulics

Perforated irrigation pipe is used to introduce the wastewater into the wetland system. The flow path through the cells is serpentine in order to provide the maximum hydraulic residence time in the system and to minimize short-circuiting. The barrier walls between the wetland cells are constructed of timber. This material poses a problem during burn-off of the wetland cells.



## Construction, Maintenance and Operational Cost

The approximate construction costs for this system were \$350,000.

### Treatment Goals

Permitted Discharge Limitations	
Oil and Grease:	10 mg/l (Daily Max)
BOD <sub>5</sub> :	30 mg/l (30-day ave)
BOD <sub>5</sub> Removal:	85%
TSS:	75 mg/l (30-day ave)
PH, su (min – max)	6.5 – 9.0 (Daily Max)
Chlorine Residual:	0.5 mg/l (Daily Max)
Fecal Coliform Bacteria:	2,000 organisms per 100 ml (Daily Max)

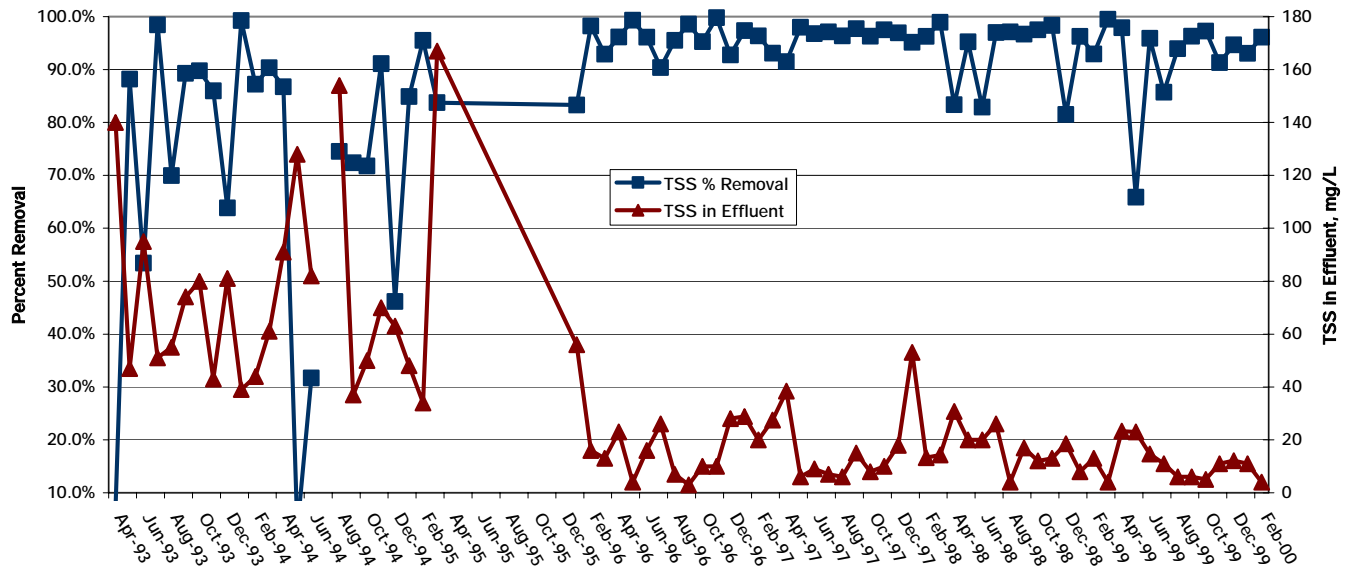
## Water Quality Data

Water quality data was obtained from CDPHE permit files

### TSS Data

The TSS graph plots the percent removal on the left axis and TSS in mg/l in the effluent on the right axis. Trends in the TSS data indicate that TSS in the effluent has consistently been below permit limitations.

**Town of Crowley TSS Performance**  
Wetlands Completed March 1994

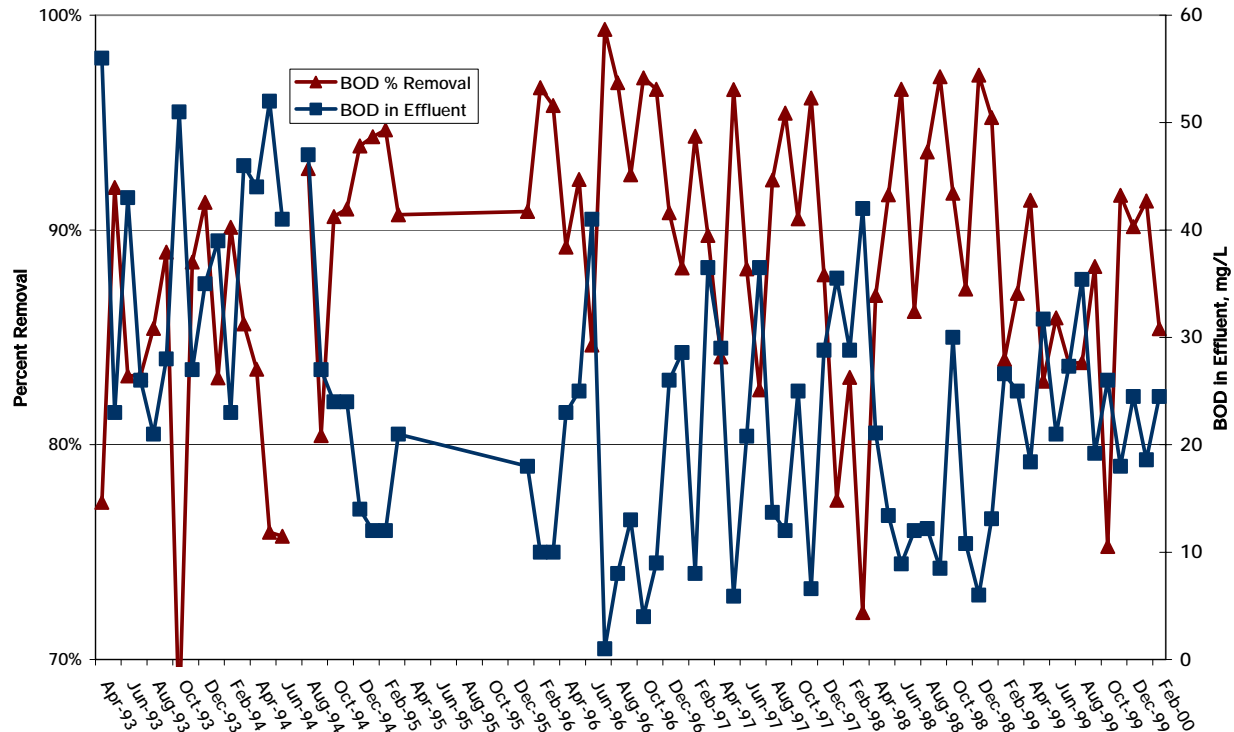


The average daily TSS in the influent, since the wetlands have been operating, has been 489 mg/l. The average TSS in the effluent is recorded to be 29 mg/l. This removal clearly meets the discharge requirements of 75 mg/l.

## BOD Data

The BOD data is plotted similarly to the TSS data, with mg/l in the effluent on the right axis, and percent removal on the left axis. Average monthly influent BOD has been 220 mg/l, the average monthly effluent from the system has been 22 mg/l. This clearly meets discharge requirements of 30 mg/l.

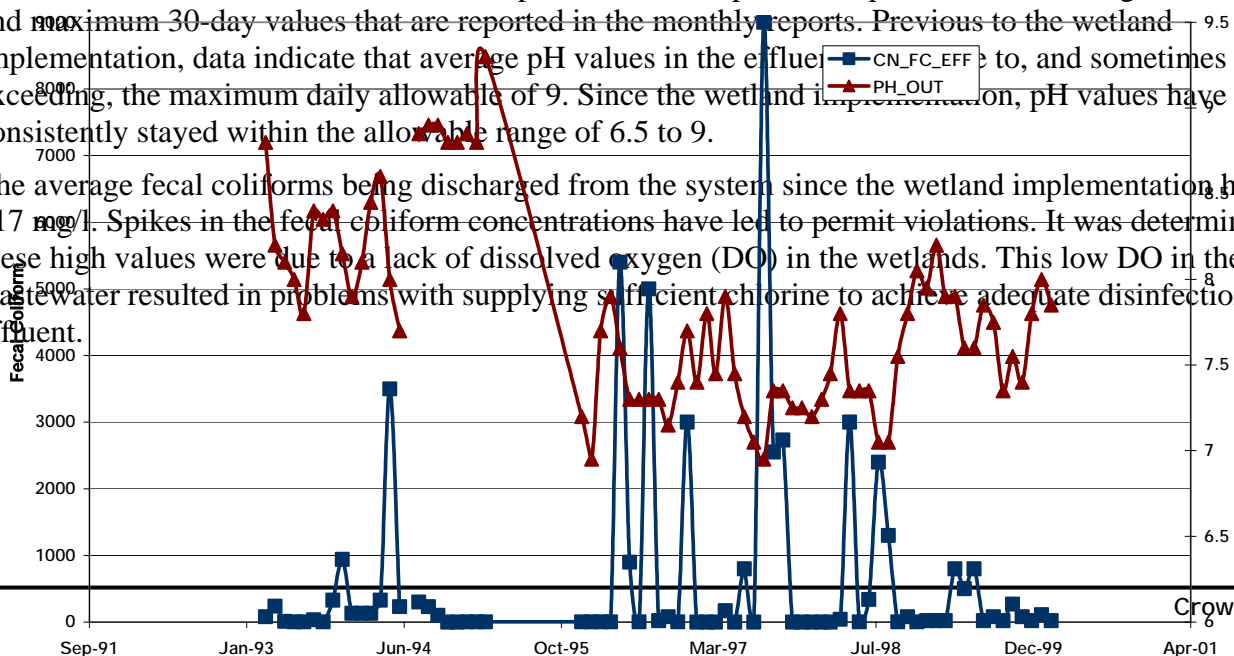
**Town of Crowley BOD Performance**  
Wetland Operational March 1994



## pH and Fecal Coliform

Data for these two categories has been plotted on the same graph. Data reflect the quality of the effluent, no influent measurements are taken for these parameters. The pH values plotted are an average of the minimum and maximum 30-day values that are reported in the monthly reports. Previous to the wetland implementation, data indicate that average pH values in the effluent were around 6.5 to 7.0, and sometimes exceeding the maximum daily allowable of 9. Since the wetland implementation, pH values have consistently stayed within the allowable range of 6.5 to 9.

The average fecal coliforms being discharged from the system since the wetland implementation have been 717 mg/l. Spikes in the fecal coliform concentrations have led to permit violations. It was determined that these high values were due to a lack of dissolved oxygen (DO) in the wetlands. This low DO in the wastewater resulted in problems with supplying sufficient chlorine to achieve adequate disinfection of the effluent.



## General Ecological Setting

The Crowley treatment wetland is located along a ditch that empties into the Arkansas River. The cells are flat, rectangular, and are 99 percent vegetated and 1 percent open water. This wetland is located in an agricultural area southeast of the Town of Crowley.

## Cell Vegetation

The Crowley site consists of two identical cells, which total 0.46 acres. The two cells support identical plant communities dominated by cattail (98 percent—*Typha latifolia*) and duckweed (3 percent—*Lemna minor*). The soil surface is inundated from 0 to 1 foot.

## Planting/Seeding

Cattails were transplanted from a nearby ditch.

## Weeds

No noxious weeds were found on the project site.

## Wildlife

The Crowley constructed wetland provides habitat for muskrat, songbirds, and waterfowl. Several bird species, including swallows, killdeer, curlew, mallard, red wing blackbird, and avocet, were observed during the site visit. The vegetation in this wetland is not structurally diverse, and probably is of limited value to wildlife. Red winged black birds probably nest in the wetland, but the wetland does not provide unique, diverse habitat for wildlife.

## Wetland Biodiversity Functional Assessment

Sediment/nutrient/toxicant removal rated high. General wildlife habitat and production export/food chain support rated moderate. Habitat diversity and uniqueness of the constructed wetland rated moderate to low. This wetland received 42 percent of the total possible functional points and was rated functionally as a category III wetland.

Wetland Biodiversity Functional Assessment.		
Function and Value Variables	Functional Points (0.1 to 1)	Possible Points
General Wildlife Habitat	0.4 (mod.)	1
General Fish/Aquatic Habitat	0.0	1
Production Export/Food Chain Support	0.7 (mod.)	1
Habitat Diversity	0.2 (low)	1
Uniqueness	0.2 (low)	1
Total Points	2.5 (50%)	5

**Wetland Biodiversity Functional Assessment.**

Function and Value Variables	Functional Points (0.1 to 1)	Possible Points
Wetland Category (I, II, III, or IV)	III	

## **Human Use**

The wastewater wetland is part of a restricted public access area, and has never been used for educational purposes. This wetland has moderate aesthetic value. It is dominated by a uniform stand of cattail.

## **Maintenance Issues**

The walls dividing cells in this wetland are wood. When cell vegetation is periodically burned, the wood walls catch on fire, which must be suppressed. If concrete walls were constructed to divide the wetland cells, this concern would be remedied.

This site was noted to have a sulfuric odor. This is due to a high influent wastewater sulfate content, apparently due to the quality of the domestic water supply. In the presence of low dissolved oxygen conditions (such as those noted in the wetlands), sulfur reducing bacteria convert sulfate to sulfide, which results in hydrogen sulfide. In addition to an odor problem, the presence of hydrogen sulfide can exert a chlorine demand that may cause problems with providing sufficient disinfection.

Pipes in the wetland require frequent 'roto-rooting' to clear-out an unidentified fibrous plant growth.

## **Overall Site Comments**

This site functions quite effectively in its intended wastewater treatment function, and has healthy vegetation cover. No major maintenance issues were noted.